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Storage Tests on Florida and Texas Grapefruit, 1950

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Storage Tests on Florida and Texas Grapefruit, 1950

This report summarizes results obtained from storage tests with Texas and Florida grapefruit made at Harlingen, Texas, during the spring and summer of 1950.

Test 1. Comparison of Florida Marsh Seedless and Duncan Grapefruit in Storage

The Florida fruit, packed in Bruce boxes with diphenyl liners (Phenodor), was shipped by express from Clermont, Florida, April 13 and received in Harlingen, Texas, April 18, 1950. Two Ryan thermometers in the shipment revealed that the transit temperatures ranged from 59° to 69° F. after an initial drop from 86° to 70° within the first 24 hours. The shipment included size 70's, 80's and 96's. Both varieties were grown on rough lemon rootstock.

Four boxes, including two size 80 of each variety, were placed in each of the three storage rooms adjusted to temperatures of 31°, 38°, and 52° F. with relative humidity at 80 to 85 percent. Two boxes, including one size 80 of each variety, were removed from each room for inspection at the end of 8 and 12 weeks storage respectively.

Two boxes of each variety, upon arrival in Harlingen, were held at 70° F. for 7 days. The total decay developed in that time was 4.0 percent in the Marsh Seedless and 3.3 percent in the Duncans.

The results of the test are summarized in tables 1 and 2.

Aging was not a factor at any temperature throughout the test. The difficulty in distinguishing between aging and pitting adjacent to the button probably accounts for a percentage of the aging recorded for fruit held at 38° F.

Pitting was largely confined to fruit from 38° storage. Marsh Seedless and Duncan were about equally affected. The total number of pitted fruits did not materially increase during the post-storage holding period of 7 days at 70° F. However there was some increase in severity of the injury during this period. Comparatively there was much less pitting in the Florida fruit than the Texas Marsh Seedless (table 5). This reduction in pitting was likely the result of the five day transit period as Hawkins and Brooks each have reported that a delay before storage at 32° decreased the amount of storage pitting.

Decay development during the storage and holding periods included in the test would indicate considerable danger involved in commercial storage with the possible exception of 8 weeks storage at 31°, and 38°, for Duncan fruit. At these temperatures little decay developed during the actual storage periods. However during the post-storage holding period, particularly between the 3rd and 7th day, there was a marked increase in decay. Surface browning as mentioned later caused an unsightly blemish on fruit held at 31°.

Penicillium rots were responsible for most of the decay developed during the holding period in fruit which had been stored at 31° F. Stem-end rot and Penicillium rots were responsible about equally for the losses in the fruit from 38° storage. Stem-end rot was the most important decay in fruit held at 52°, most of which developed during the actual storage period.

Surface browning and watery breakdown are not listed in tables 1 and 2. Both disorders occurred in fruit stored at 31° F. Marsh Seedless after 8 weeks storage showed 21 percent of the fruit affected with surface browning the day withdrawn with an increase to 80 percent after 3 days at 70°. Duncan fruit for the same storage period showed 22 percent affected with an increase to 52 percent in 3 days. A higher percentage of fruit developed surface browning during the 12 weeks storage period. Marsh Seedless and Duncan fruit showed 41 and 49 percent affected the day withdrawn with increases to 49 and 66 percent respectively after 3 days at 70°.

Although the dessert quality is not affected by surface browning the appearance of the fruit suffers and in all probability surface browning would result in the fruit being discounted in price.

Watery breakdown was particularly severe and largely limited to the Marsh Seedless fruit held at 31°. Approximately 48 percent of the fruit in these two lots was discarded during the holding periods following 8 and 12 weeks storage. There is some question whether or not the fruit had been frozen by the long exposure to 31° temperature.

The general appearance of the sound fruit was not materially changed after 8 and 12 weeks storage at 31°, 38°, or 52° F. Fruit stored at 31° and 38° retained its original greenish yellow color while fruit held at 52° had developed a slight orange yellow color. Softening was more pronounced in the 31° fruit, particularly the Marsh Seedless. The best post-storage appearance was evident in the sound Duncan fruit held at 38°. Unfortunately there were few sound fruits remaining in any of the lots after decay, pitting, watery breakdown and surface browning had completed their attack.

In tables 3 and 4 are given the data on volume of juice per fruit, weight of fruit that was juice, total solids, total acid, solids/acid ratio, juice flavor and internal drying index numbers.

Internal drying was quite evident in both varieties of Florida grapefruit particularly the Marsh Seedless.

Test 2. Storage of Texas Marsh Seedless Grapefruit

The Marsh Seedless grapefruit used in this test was obtained from a 15-year old orchard on sour orange rootstock. The fruit was harvested March 9 and packed at the Pride O'Texas house (10 miles N. W. of Mission) March 10, 1950. The fruit was fully colored so was not subjected to ethylene coloring. After the regular packing house processing the fruit was packed in Bruce boxes with diphenyl liners (Phenodor). There was little selection to be had in the matter of fruit sizes which ran mostly 112's and smaller. Fourteen boxes including one 64's, seven 80's, and one 96's and five 112's were trucked to Harlingen and placed in storage March 11, 1950.

Four boxes were placed in each of the three storage rooms adjusted to temperatures of 31°, 38°, and 52° F., with relative humidity at 80 to 85 percent. Two boxes were removed from each room for inspection at the end of 8 and 12 weeks storage respectively.

Two boxes were held at 70° for one week to determine the decay potential. No decay developed during this initial holding period.

The results of this test are summarized in table 5.

Aging was largely confined to the fruit held at 38°. Here again, as pointed out in Test 1, the difficulty in distinguishing between aging and pitting adjacent to the button may account for a percentage of the aging recorded at this temperature.

Pitting was particularly severe in the fruit held at 38° as has been demonstrated in the past. There was little difference either in the number of fruits affected or the degree of severity in the two storage periods at 38°. Likewise the number of fruits affected did not increase during the post-storage holding period. Although fruit from the 31° room was practically free from pitting when withdrawn from storage there was a progressive increase in the number of fruits affected and the degree of severity during the holding period at 70°.

Decay development during the actual storage periods at 31° and 38° was nearly zero. Practically all the decay developed between the 3rd and 7th day of the holding period. In contrast, decay in the fruit held at 52° developed during the storage periods and showed little increase during the holding period.

Penicillium rots were responsible for nearly all the decay with only a trace of stem-end rot developing in the fruit from the 52° storage.

Surface browning is not listed in table 5. However it did develop during the holding period in fruit held at 31° for 8 weeks showing an increase from 0.7 percent to 16.8 percent in the 7 day period. In the 12 weeks storage period surface browning developed in both the 31° and 38° fruit during storage with 80 and 33 percent of the fruit affected at the two temperatures respectively. There was little increase during the holding period.

Watery breakdown was of no importance in this test.

There was little change in the general appearance of the sound fruit after 8 and 12 weeks storage at 31°, 38°, or 52° F. Fruit stored at 31° and 38° had retained its original greenish yellow color while fruit held at 52° had acquired a deeper orange yellow color. All the fruit was fairly firm to firm. However the severe pitting of the fruit held at 38° for 8 and 12 weeks would have prevented the sale of such fruit. Likewise the pronounced surface browning of the fruit held at 31° for 12 weeks seriously detracted from its appearance. The fruit held at 52° was by far the best in appearance.

A summary of the information on volume of juice per fruit and other routine tests is presented in table 6.

Test 3. Decay Control Tests on Texas Marsh Seedless Grapefruit in Storage

The source of fruit and place of packing was the same as described in Test 2. The fruit was picked March 9, packed March 10 and placed in storage March 10, 1950.

The fruit was divided into four lots upon delivery in field boxes to the packing house. Each of the four lots received a different pre-packing treatment as follows:

A. Check - no fungicidal treatment.

B. Borax dip - 5 percent - 30 seconds.

C. Borax dip plus NCl_3 - (Decco) 0.1 p.p.m. - 4 hours.

D. NCl_3 (Decco) - 0.1 p.p.m. - 4 hours.

After regular packing house processing the fruit from each lot receiving a pre-packing treatment was packed in Bruce boxes as follows: (1) naked, (2) plain wraps, (3) diphenyl wraps, and (4) diphenyl liners (Phenodor). Four boxes of each type of packing for each of the four pre-packing treatments, making a total of 64 boxes, were placed in the 52° room for 8 and 12 weeks storage.

In addition two boxes of naked fruit from each of the four pre-packing treated lots were held at 70° for one week for decay development. The total amount of decay developed in this period on fruit from each of the four treatments is shown by the following percentages: check - 1.2; borax - 0.4; borax plus NCl_3-0.8 and NCl_3-3.0.

The results of the test are summarized in tables 7 and 8.

Although complete notes were made on aging, pitting, surface browning and watery breakdown the occurrence of these disorders were of little importance and are not listed in tables 7 and 8. Pitting and aging were encountered in all lots, particularly in borax-treated fruit. No surface browning or watery breakdown was observed in any of the test fruit.

The most striking point in decay development was the extremely low percentage of stem-end rot in all lots in both the 8 and 12 weeks storage periods. Near perfect control had been obtained but it is difficult to credit the success to any of the decay preventative treatments used in the test. Penicillium molds were responsible for most of the decay. No one treatment was outstanding in the control of this decay. Nitrogen trichloride appeared to induce greater development of penicillium rot perhaps because of some weakening effect to the rind of the grapefruit. Similar results were obtained in the storage tests conducted in 1948.

The fact that a small percentage of stem-end rot was found in nearly every lot eliminates the possibility of its non-existence in the Upper Valley. In previous years grapefruit for storage tests had been obtained from orchards in the Lower Valley, an area where the melanose disease is much more prevalent than in the Upper Valley. The Phomopsis fungus is the causal agent of melanose and one of the two stem-end rot decays found in Texas fruit. Winston has suggested the possibility that long storage at 52° or lower temperatures inactivates the Diplodia stem-end fungus and that Phomopsis is the chief cause of stem-end rot in storage fruit. There is considerable evidence accumulating which supports Winston's hypothesis.

Test 4. Effect of Dilute Orchard Sprays of 2,4-D on Storage Quality of Marsh Seedless Grapefruit

An informal agreement with Rio Farms (20 miles north of Weslaco) provided for a source of Marsh Seedless grapefruit for storage from trees which had received dilute sprays of 2,4-D acid equivalent. The trees were in good condition in a 17-year old orchard on sour orange rootstock. The fruit was sized in the orchard and the 80's and 96's placed directly in storage with no treatment other than plain wraps. Storage was for 14 weeks at temperatures of 31° and 52° F. Examinations were made in 6, 10, and 14 weeks. After the last withdrawal the fruit was held at 70° for one week.

The results of the test are presented in tables 9 and 10.

No changes in the storage behavior of the fruit could be attributed to the hormone sprays. In respect to aging, pitting, surface browning, and watery breakdown the pattern was similar as described in Test 2.

Decay development was of particular interest in that stem-end rot was of little importance in any of the lots. The fact that untreated fruit had developed so little stem-end rot in 14 weeks storage was additional evidence that the source of Texas fruit might be an important factor in determining its storage life.

Penicillium rots again were responsible for most of the decay in fruit held at 31°, developing between the 3rd and 7th day of the post-storage holding period. Fruit from the 1st picking stored at 31° were probably not susceptible to attack by Penicillium because of their early picking date and lack of maturity.

The fruit held at 52° had a much better appearance than fruit held at 31°. Although considerable slight pitting was recorded for the fruit of the 2nd picking it is doubtful if the average buyer would have noticed it. The fruit was fairly firm at the start of the holding period but softened noticeably during the 7 days at 70°. However fruit which had softened during the holding period was replaced in 52° storage and regained much of its original firmness.

Complete juice analyses were not made on this fruit at the start of the storage period. However the following data are given for the record.

Fruit from check lots - picked March 22, 1950

	Before Storage	14 Weeks Storage 52° plus 7 Days 70°
Volume of juice per fruit - ml.	193	210
Weight of fruit that was juice - %	-	50
Total solids - %	12.8	12.5
Total acid - %	1.36	1.09
Solids - acid ratio	9.41	11.47
Flavor	Good	Fair-good
Internal drying index No.	0	0

Summary

Florida Fruit: The results obtained from the storage tests with Marsh Seedless and Duncan fruit did not indicate the feasibility of commercial application. Decay development during the storage and post-storage holding periods, with the exception of Duncan fruit held for 8 weeks at 31° and 38° F., was a factor which alone would make rather hazardous the prolonged storage of Florida grapefruit. Temperatures of 31° and 38° afforded good control of decay organisms during the actual storage periods but the fruit was particularly susceptible to Penicillium molds during the 7 day post-storage holding period. Poor decay control was provided by storage at 52°.

Surface browning and pitting was largely confined to fruit held at 31° and 38° respectively. The incidence of pitting may have been reduced somewhat by the "curing" obtained from the five days in transit.

Watery breakdown was especially severe in Marsh Seedless fruit held at 31°. The possibility is suggested that the low solids Marsh fruit had been frozen at this temperature.

Changes in the composition of the juice during storage were not too evident with the exception of Marsh Seedless fruit held for 12 weeks at 52° which showed a marked decrease in total acid. The most consistent decreases in total acid occurred with both varieties during the holding periods following 8 and 12 weeks storage at the three temperatures.

Comparatively the storage behavior of the Duncan fruit was better than that of the Marsh Seedless in respect to juice composition and less development of decay, watery breakdown and internal drying.

Texas Fruit: Successful storage of Marsh Seedless grapefruit for 8, 12, and 14 weeks was accomplished in 1950 on an experimental level. Results indicated small-scale commercial storage may be practical.

This year very little stem-end rot developed in the Marsh Seedless fruit regardless of its treatment or storage temperature. A possible explanation for this phenomenon is that the fruit, for the first time, was obtained from the Upper Valley, an area where the Phomopsis organism is not well established as evidenced by the absence of melanose in the orchards. In Texas Phomopsis appears to be largely responsible for the stem-end rot occurring in storage fruit while Diplodia is more prevalent in fresh fruit.

The best results were obtained from storage at 52° in that pitting and surface browning were of minor importance and less Penicillium decay developed during the post-storage holding period.

Nitrogen trichloride alone was not effective as a pre-packing treatment for the control of Penicillium molds. The most consistent reduction in Penicillium decay was obtained with the borax dip as a pre-packing treatment. The effectiveness of the borax dip was further enhanced by the use of diphenyl wraps and diphenyl liners as packing treatments.

The composition of the juice was affected very slightly during the storage and holding periods. Dessert quality was acceptable throughout the tests.

Table 1. Florida Marsh Seedless and Duncan Grapefruit 1/

8 Weeks Storage - Harlingen, Texas - 1950

Marsh Seedless

Treatment 3/	Storage Temperature	No. of Frt.	First Inspection: Weight Loss In Transit	First Inspection: Weight Loss In Storage	First Inspection: Aging Slight	First Inspection: Aging Severe	First Inspection: Pitting Slight	First Inspection: Pitting Moderate	First Inspection: Pitting Severe	First Inspection: Decay Stem end Rot	First Inspection: Decay Penicillium Rot	First Inspection: Decay Other	First Inspection: Decay Total	2nd Inspection-After 3 Days at 70°F. 2/: Aging Slight	2nd Inspection: Aging Severe	2nd Inspection: Pitting Slight	2nd Inspection: Pitting Moderate	2nd Inspection: Pitting Severe	2nd Inspection: Decay Stem end Rot	2nd Inspection: Decay Penicillium Rot	2nd Inspection: Decay Other	2nd Inspection: Decay Total	3rd Inspection-After 7 Days at 70°F. 2/: Aging Slight	3rd Inspection: Aging Severe	3rd Inspection: Pitting Slight	3rd Inspection: Pitting Moderate	3rd Inspection: Pitting Severe	3rd Inspection: Decay Stem end Rot	3rd Inspection: Decay Penicillium Rot	3rd Inspection: Decay Other	3rd Inspection: Decay Total
	°F.		%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
P	31	175	1.2	4.1	0	0.6	3.4	0	0	0.6	0	0	0.6	0.6	0	4.6	0	0	0.6	0.6	1.1	2.3	0	0	2.3	0.6	0	0.6	22.3	1.1	24.0
P	38	176	1.1	2.6	5.1	2.3	17.6	10.2	14.8	0.6	3.4	6.3	10.3	12.5	3.4	19.9	12.5	16.5	1.7	4.5	7.4	13.6	9.1	0.6	20.5	6.3	8.5	9.7	11.3	7.4	28.4
P	52	176	1.3	4.5	0.6	0	0	0	0	23.9	10.2	1.7	35.8	0	0.6	0.6	0	0	23.0	16.5	1.7	47.2	0	0.6	0	0	0	29.0	23.9	2.3	55.2

Duncan

Treatment 3/	Storage Temperature	No. of Frt.	First Inspection: Weight Loss In Transit	First Inspection: Weight Loss In Storage	First Inspection: Aging Slight	First Inspection: Aging Severe	First Inspection: Pitting Slight	First Inspection: Pitting Moderate	First Inspection: Pitting Severe	First Inspection: Decay Stem end Rot	First Inspection: Decay Penicillium Rot	First Inspection: Decay Other	First Inspection: Decay Total	2nd Inspection-After 3 Days at 70°F. 2/: Aging Slight	2nd Inspection: Aging Severe	2nd Inspection: Pitting Slight	2nd Inspection: Pitting Moderate	2nd Inspection: Pitting Severe	2nd Inspection: Decay Stem end Rot	2nd Inspection: Decay Penicillium Rot	2nd Inspection: Decay Other	2nd Inspection: Decay Total	3rd Inspection-After 7 Days at 70°F. 2/: Aging Slight	3rd Inspection: Aging Severe	3rd Inspection: Pitting Slight	3rd Inspection: Pitting Moderate	3rd Inspection: Pitting Severe	3rd Inspection: Decay Stem end Rot	3rd Inspection: Decay Penicillium Rot	3rd Inspection: Decay Other	3rd Inspection: Decay Total
	°F.		%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
P	31	151	1.0	3.7	0.7	0	5.3	2.0	0	0	0	0.7	0.7	0	0	6.0	1.3	2.0	0	0	0.7	0.7	0	0	8.6	3.3	4.0	0.7	6.6	2.7	10.0
P	38	152	1.1	2.3	4.6	1.3	22.4	7.2	7.2	1.3	0	0	1.3	4.6	3.3	23.7	12.5	12.5	1.3	1.3	0	2.6	5.3	2.0	27.0	13.2	11.2	3.9	3.9	0	7.8
P	52	152	0.9	2.9	0	0	0	0	0	11.8	1.3	0	13.1	1.3	0	3.3	0	0	11.8	2.6	0	14.4	0.7	0	2.0	0	0	14.4	4.6	0.7	19.7

1/ Express shipment - Clermont, Florida - April 13, 1950. Received and placed in storage Harlingen, Texas - April 18, 1950.

2/ Decay data, 2nd and 3rd inspection, cumulative. Pitting and aging data, 2nd and 3rd inspection, not cumulative.

3/ P- Phenodor liners - naked fruit.

Table 2. Florida Marsh Seedless and Duncan Grapefruit 1/

12 Weeks Storage - Harlingen, Texas - 1950

Marsh Seedless

Storage Temperature	No. of Frt.	First Inspection: Weight Loss		2nd Inspection - After 3 Days at 70°F. 2/												3rd Inspection - After 7 Days at 70°F. 2/											
				Aging		Pitting			Decay					Aging		Pitting			Decay					Aging		Pitting			Decay			
		In Transit	In Storage	Slight	Severe	Slight	Moderate	Severe	Stem end Rot	Penicillium Rot	Other	Total	Slight	Severe	Slight	Moderate	Severe	Stem end Rot	Penicillium Rot	Other	Total	Slight	Severe	Slight	Moderate	Severe	Stem end Rot	Penicillium Rot	Other	Total
°F		%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
31	177	1.1	6.3	1.1	0	2.3	0	0	0	0	0	0	0	0	2.3	0	0	0	0.6	2.3	2.9	0	0	0	0	0	0	43.5	3.4	46.9
38	175	1.2	4.6	17.1	10.3	26.9	13.7	19.4	0	0.6	1.7	2.3	15.4	11.4	24.6	14.3	23.4	3.4	3.5	1.7	8.6	7.4	6.9	16.0	5.7	6.9	27.4	22.4	1.7	51.5
52	170	1.2	7.9	0	0	1.2	0	0	49.4	1.8	11.8	63.0	0	0	0.6	0	0	50.0	5.9	15.5	72.4	0	0	0	0	0	51.8	11.7	18.3	84.8

Duncan

31	152	1.0	5.0	2.6	0.7	8.6	0.7	0	0.7	0	0	0.7	2.0	0.7	6.6	0.7	1.3	0.7	0	1.3	2.0	0.7	0.7	1.3	0.7	0	0.7	31.6	1.3	33.6
38	152	1.2	3.9	8.6	4.6	19.7	6.6	7.9	2.6	0.7	0	3.3	7.2	5.3	19.7	5.9	9.9	2.6	4.6	0.7	7.9	5.3	5.3	17.8	7.2	6.6	12.5	18.4	0.7	31.6
52	151	1.1	7.1	0	0	2.6	0	0	34.4	2.6	11.9	48.9	0	0	2.6	0	0	35.7	3.9	12.6	52.2	0	0	1.3	0	0	39.0	7.2	14.6	60.8

Express shipment - Clermont, Florida - April 13, 1950. Received and placed in storage Harlingen, Texas - April 18, 1950.

Decay data, 2nd and 3rd inspection, cumulative. Pitting and aging data, 2nd and 3rd inspection, not cumulative.

P - Phenodor liners - naked fruit.

Table 3. Changes in the Composition of Florida Marsh Seedless Grapefruit After 8 and 12 Weeks Storage at 31°, 38° or 52°F., Plus 7 Days at 70°F. 1/

Storage Treatment	Volume of Juice Per Fruit	Weight of Fruit That Was Juice	Total Solids	Total Acid	Solids-Acid Ratio	Dessert Quality	
						Flavor	Internal Drying Index No. 2/
	Ml.	Percent	Percent	Percent			
Initial Holding - 3rd day	215	50	9.3	.76	12.24	Good	0
" " 7th day	200	48	8.4	.70	12.00	do	0
8 Weeks at 31°F.-3rd day	180	46	9.4	.80	11.75	Fair	10
" " " " 7th day	167	43	9.2	.72	12.78	do	13
12 Weeks at 31°F.-3rd day	166	43	9.1	.69	13.19	-	16
" " " " 7th day	(Watery breakdown plus decay accounted for balance of fruit)						
8 Weeks at 38°F.- 3rd day	187	46	9.2	.80	11.50	Poor	12
" " " " 7th day	181	46	8.7	.66	13.18	do	11
12 Weeks at 38°F.-3rd day	176	44	9.0	.70	12.86	Poor	22
" " " " 7th day	182	44	9.2	.62	14.84	do	31
8 Weeks at 52°F.- 3rd day	189	47	9.5	.76	12.50	Poor	10
" " " " 7th day	164	42	8.2	.63	13.02	do	25
12 Weeks at 52°F- 3rd day	173	43	8.6	.61	14.10	Poor	30
" " " " 7th day	173	45	9.0	.60	15.00	do	19

1/ Juice analyses made on the 3rd and 7th days of initial and post-storage holding period at 70°F. Each sample consisted of 18 to 25 fruits, size 80.

2/ Internal drying index values assigned on the basis of 10, 20, and 40 points per fruit for slight, moderate and severe drying respectively.

Table 4. Changes in the Composition of Florida Duncan Grapefruit After 8 and 12 Weeks Storage at 31°, 38° or 52°F., Plus 7 Days at 70°F. 1/

Storage Treatment	Volume of Juice Per Fruit	Weight of Fruit That Was Juice	Total Solids	Total Acid	Solids-Acid Ratio	Dessert Quality	
						Flavor	Internal Drying Index No. 2/
	Ml.	Percent	Percent	Percent			
Initial Holding - 3rd day	193	45	10.2	1.02	10.00	Good	0
" " 7th day	196	46	10.8	1.12	9.64	do	0
8 Weeks at 31°F-3rd day	183	44	10.3	1.00	10.30	Fair	7
" " " " 7th day	167	41	9.9	0.85	11.65	do	4
12 Weeks at 31°F- 3rd day	165	40	10.6	1.00	10.60	Fair	6
" " " " 7th day	172	43	10.8	1.01	10.69	do	6
8 Weeks at 38°F- 3rd day	171	42	10.8	1.03	10.49	Fair	19
" " " " 7th day	169	42	10.3	0.93	11.08	do	7
12 Weeks at 38°F- 3rd day	163	39	10.3	0.90	11.44	Poor	18
" " " " 7th day	165	42	10.1	0.84	12.02	do	21
8 Weeks at 52°F- 3rd day	186	45	10.9	0.95	11.47	Fair	14
" " " " 7th day	173	42	11.1	0.86	12.91	do	13
12 Weeks at 52°F- 3rd day	168	41	10.6	0.92	11.52	Poor	14
" " " " 7th day	176	44	10.5	0.83	12.65	do	13

1/ Juice analyses made on the 3rd and 7th days of initial and post-storage holding period at 70°F. Each sample consisted of 25 fruits, size 80.

2/ Internal drying index values assigned on the basis of 10, 20, 40 points per fruit for slight moderate and severe drying respectively.

Table 5. Texas Marsh Seedless Grapefruit 1/
8 and 12 Weeks Storage - Harlingen, Texas - 1950

8 Weeks Storage

Treatment 3/	Storage Temp.	No. of Frt.	First Inspection: Aging: Slight	Aging: Severe	Pitting: Slight	Pitting: Moderate	Pitting: Severe	Decay: Stem end Rot	Decay: Penicillium Rot	Decay: Other	Decay: Total	2nd Inspection - After 3 Days at 70°F. 2/: Aging: Slight	Aging: Severe	Pitting: Slight	Pitting: Moderate	Pitting: Severe	Decay: Stem end Rot	Decay: Penicillium Rot	Decay: Other	Decay: Total	3rd Inspection - After 7 Days at 70°F. 2/: Aging: Slight	Aging: Severe	Pitting: Slight	Pitting: Moderate	Pitting: Severe	Decay: Stem end Rot	Decay: Penicillium Rot	Decay: Other	Decay: Total
	°F		%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
P	31	144	0	0	0.7	0	0	0	0	0	0	0	0	9.7	2.1	1.4	0	0.7	0	0.7	0.3	0	10.1	26	25	0	15.8	0	15.8
P	38	164	18.9	15.9	4.9	11.6	82.9	0	0.6	0	0.6	22.0	20.1	3.0	9.8	86.0	0	1.2	0	1.2	14.4	6.6	0.7	36	84.0	0	10.6	0	10.6
P	52	160	0	0	0	0	0	0	3.1	0	3.1	0	0	0	0	0	0.6	3.7	0	4.3	0	0	0	0	0	0.6	4.3	0	4.9

12 Weeks Storage

P	31	191	2.1	0	3.1	1.0	1.0	0	0	0	0	3.1	0	7.3	3.7	1.0	0	0	0	0	47	1.6	8.9	5.8	5.8	0	14.1	0.5	14.6
P	38	192	18.2	10.9	6.3	10.4	79.7	0	2.1	0	2.1	19.3	12.5	5.7	10.4	78.1	0	4.7	0	4.7	20.4	12.0	7.2	11.4	7.4	0	19.7	0	19.7
P	52	226	3.5	0	0.9	0	0	0	4.9	0.4	5.3	3.5	0	0.9	0	0	0	4.9	0.4	5.3	3.5	0.4	0.9	0	0	0.4	5.3	0	6.1

1/ Upper Valley fruit (Pride O'Texas) picked March 9 - Packed March 10 - Placed in Storage at Harlingen, March 11, 1950.
2/ Decay data, 2nd and 3rd inspection, cumulative. Pitting, aging data, 2nd and 3rd inspection, not cumulative.
3/ P - Phenodor liners - naked fruit.

Table 6. Changes in the Composition of Texas Marsh Seedless Grapefruit After 8 and 12 Weeks Storage at 31°, 38° or 52°F., Plus 7 Days at 70°F. 1/

Storage Treatment	Volume of Juice Per Fruit	Weight of Fruit That Was Juice	Total Solids	Total Acid	Solids-Acid Ratio	Dessert Quality: Flavor	Dessert Quality: Internal Drying Index No. 2/
	Ml.	Percent	Percent	Percent			
Initial Holding - 3rd day	189	49	12.6	1.23	10.24	Good	0
" " 7th day	186	49	12.5	1.17	10.68	do	0
8 Weeks at 31°F.- 3rd day	184	49	12.0	1.08	11.11	Good	0
" " " " 7th day	174	49	12.4	1.13	10.97	do	0
12 Weeks at 31°F.- 3rd day	182	50	11.8	1.06	11.13	Fair	3
" " " " 7th day	162(96's)	49	11.9	1.04	11.44	do	11
8 Weeks at 38°F.- 3rd day	180(96's)	52	11.9	1.07	11.12	Fair	0
" " " " 7th day	172(96's)	51	12.1	1.06	11.42	do	0
12 Weeks at 38°F.- 3rd day	163(96's)	50	12.4	1.14	10.88	Fair	5
" " " " 7th day	166(96's)	51	12.2	1.13	10.80	do	7
8 Weeks at 52°F.- 3rd day	197	52	11.9	1.11	10.72	Fair	0
" " " " 7th day	186	50	12.2	1.08	11.30	do	1
12 Weeks at 52°F.- 3rd day	195	51	11.8	0.99	11.92	Fair	9
" " " " 7th day	180	50	11.8	0.94	12.61	do	12

1/ Juice analyses made on the 3rd and 7th days of initial and post-storage holding period at 70°F. Each sample consisted of 15 to 25 fruits, size 80 unless specified.

2/ Internal drying index values assigned on the basis of 10, 20, and 40 points per fruit for slight, moderate and severe drying respectively.

Table 7. Fungicidal Treatments for Packing House Application
Marsh Seedless Grapefruit - Pride O'Texas (Upper Valley) - March 10, 1950
8 Weeks Storage at 52°F. - Harlingen, Texas

Fungicidal Treatment			First Inspection				2nd Inspection - After 3 Days at 70°F.				3rd Inspection - After 7 Days at 70°F.			
Pre-Packing	Packing Wraps, Etc	Total Fruits	Percent Decay				Percent Decay (Cumulative)				Percent Decay (Cumulative)			
			S.E.R.	Penic.	Other	Total	S.E.R.	Penic.	Other	Total	S.E.R.	Penic.	Other	Total
None Check	Naked	221	0.5	3.2	0	3.7	0.5	3.7	0	4.2	0.5	4.2	0	4.7
	Plain	209	0.5	7.2	0	7.7	0.5	7.7	0	8.2	0.5	8.2	0	8.7
	Diphenyl	176	0	1.7	0	1.7	0.6	1.7	0.6	2.9	0.6	2.8	1.2	4.6
	Phenodor	208	0.5	1.0	0.5	2.0	0.5	1.5	0.5	2.5	0.5	2.0	0.5	3.0
Borax Dip 5% - 30 Secs.	Naked	250	0.8	0.4	3.2	4.4	0.8	0.4	3.2	4.4	1.2	0.8	4.0	6.0
	Plain	209	0	0.5	0.5	1.0	1.4	1.0	0.5	2.9	3.3	2.0	1.0	6.3
	Diphenyl	208	0.5	0	0	0.5	0.5	0	0	0.5	1.9	0	0.5	2.4
	Phenodor	250	1.6	0	0.4	2.0	1.6	0	0.4	2.0	2.4	0.4	0.4	3.2
Borax Plus NCl_3 0.1 p.p.m. 4 hours	Naked	70	0	1.4	1.4	2.8	0	1.4	1.4	2.8	0	1.4	4.3	5.7
	Plain	178	0	1.1	0.6	1.7	0	1.1	0.6	1.7	0	1.1	0.6	1.7
	Diphenyl	190	0.5	2.1	0.5	3.1	0.5	2.1	0.5	3.1	0.5	3.7	0.5	4.7
	Phenodor	125	0	0	0.8	0.8	1.6	0	0.8	2.4	4.0	0	0.8	4.8
NCl_3 0.1 p.p.m. 4 hours	Naked	222	0.9	8.1	0	9.0	0.9	8.1	0	9.0	1.4	9.5	0.5	11.4
	Plain	226	0.4	10.6	0	11.0	0.8	11.0	0	11.8	1.7	11.4	0.4	13.5
	Diphenyl	176	1.1	4.0	0	5.1	1.1	4.0	0	5.1	1.7	4.6	0	6.3
	Phenodor	189	0.5	4.8	0	5.3	1.0	4.8	0	5.8	1.0	6.4	0	7.4

Table 8. Fungicidal Treatments for Packing House Application
Marsh Seedless Grapefruit - Pride O'Texas (Upper Valley) - March 10, 1950
12 Weeks Storage at 52°F. - Harlingen, Texas

Fungicidal Treatment			First Inspection				2nd Inspection - After 3 Days at 70°F.				3rd Inspection - After 7 Days at 70°F.			
Pre-Packing	Packing Wraps, Etc	Total Fruits	Percent Decay				Percent Decay (Cumulative)				Percent Decay (Cumulative)			
			S.E.R.	Penic.	Other	Total	S.E.R.	Penic.	Other	Total	S.E.R.	Penic.	Other	Tot
None Check	Naked	252	4.0	4.0	0	8.0	4.0	4.4	0	8.4	4.8	6.4	1.6	12.8
	Plain	226	0.4	2.2	0	2.6	0.4	2.2	0	2.6	2.6	3.1	0	5.7
	Diphenyl	225	0	4.4	0	4.4	0.9	4.8	0.4	6.1	0.9	5.2	0.4	6.5
	Phenodor	224	0	2.2	0.4	2.6	0	2.6	0.4	3.0	0	3.9	0.4	4.3
Borax Dip 5% - 30 secs.	Naked	250	5.6	0.4	1.2	7.2	6.8	0.4	1.2	8.4	6.8	1.6	2.4	10.8
	Plain	193	3.1	0.5	0.5	4.1	3.1	1.0	0.5	4.6	3.1	1.0	1.0	5.1
	Diphenyl	176	1.1	0	1.1	2.2	1.1	0	1.1	2.2	1.1	0	1.1	2.2
	Phenodor	250	3.6	0.4	0.8	4.8	3.6	0.4	1.2	5.2	4.0	0.4	2.0	6.4
Borax Plus NCl_3 0.1 p.p.m. 4 hours	Naked	222	0.9	0.5	1.8	3.2	0.9	0.5	2.3	3.7	0.9	3.1	3.2	7.2
	Plain	193	0.5	2.1	1.0	3.6	0.5	2.1	1.0	3.6	0.5	2.1	3.1	5.7
	Diphenyl	192	2.1	0.5	1.0	3.6	2.1	0.5	1.6	4.2	2.1	0.5	1.6	4.2
	Phenodor	176	4.0	1.1	0.6	5.7	4.0	1.1	1.1	6.2	4.5	1.7	2.3	8.5
NCl_3 0.1 p.p.m. 4 hours	Naked	238	4.2	6.7	0.4	11.3	5.0	7.1	0.4	12.5	5.0	10.5	1.7	17.2
	Plain	225	3.1	12.0	0	15.1	3.1	12.0	0	15.1	3.5	14.2	0.4	18.1
	Diphenyl	176	2.8	5.7	0	8.5	3.4	5.7	0	9.1	4.0	6.3	0	10.3
	Phenodor	238	0.8	8.4	1.7	10.9	0.8	8.8	1.7	11.3	0.8	10.5	3.4	14.7

Table 9. The Effect of Dilute Orchard Sprays of 2,4-D on Storage Quality of Marsh Seedless Grapefruit 1/
First Picking - Dec. 4, 1949 - Rio Farms (Upper Valley)
14 Weeks Storage - Harlingen, Texas

Treatment	Storage Temp.	No. of Fruits	First Inspection								2nd Inspection - After 2/ 3 Days at 70°F.								3rd Inspection - After 2/ 7 Days at 70°F.							
					Pitting			Decay					Pitting			Decay					Pitting			Decay		
			Surface Browning	Aging	Slight	Moderate	Severe	S.E.R.	Penicil.	Total	Surface Browning	Aging	Slight	Moderate	Severe	S.E.R.	Penicil.	Total	Surface Browning	Aging	Slight	Moderate	Severe	S.E.R.	Penicil.	Total
	°F		%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
M-1 3/	31	200	74.5	26.0	18.0	12.0	20.0	0	0	0	86.0	32.0	25.0	23.0	45.0	0.5	0	0.5	87.0	43.0	25.0	28.0	43.0	0.5	2.0	2.5
M-3 4/	31	200	73.5	27.0	14.0	6.0	7.0	0	0	1.0	85.0	41.0	28.0	23.0	30.0	2.0	0.5	3.5	77.0	53.0	26.0	25.0	34.0	2.5	8.5	12.0
M-1 3/	52	200	0	0	0.5	0.5	0	0.5	0	0.5	0	0	0.5	0.5	0	0.5	0	0.5	0	0	0.5	0.5	0	0.5	0	0.5
M-3 4/	52	200	0	0	0.5	0.5	0	1.0	0	1.5	0	0	0.5	0	0.5	1.0	0	1.5	0	0.5	1.0	0	0.5	3.0	0	3.5

1/ Fruit sized in orchard (80's and 96's) and placed in storage Dec. 5, 1949 with no treatment other than plain wraps.

2/ Decay data, 2nd and 3rd inspections, cumulative. Surface browning, pitting and aging data not cumulative.

3/ M-1 plot sprayed Oct. 6, 1949 (8 p.p.m. 2,4-D acid equivalent).

4/ M-3 plot - check - no spray.

Table 10. The Effect of Dilute Orchard Sprays of 2,4-D on Storage Quality of Marsh Seedless Grapefruit 1/
Second Picking - March 22, 1950 - Rio Farms (Upper Valley)
14 Weeks Storage - Harlingen, Texas

Treatment	Storage Temp.	No. of Frt.	First Inspection								2nd Inspection - After 2/ 3 Days at 70°F.								3rd Inspection - After 2/ 7 Days at 70°F.							
				Pitting				Decay					Pitting				Decay				Pitting				Decay		
			Surface Browning	Aging	Slight	Moderate	Severe	S.E.R.	Penicil.	Total	Surface Browning	Aging	Slight	Moderate	Severe	S.E.R.	Penicil.	Total	Surface Browning	Aging	Slight	Moderate	Severe	S.E.R.	Penicil.	Total
	°F		%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%
M-1 3/	31	199	67.3	1.0	1.0	0	0	0	0	0	77.4	1.0	7.0	3.0	1.0	0	1.0	1.0	41.2	0.5	5.0	2.0	1.0	1.0	42.2	43.2
M-2 4/	31	199	94.5	0	2.0	0	0	0	0	0	94.0	1.0	4.0	0	0.5	0	0.5	0.5	50.8	0	1.0	0	0	0	40.2	40.2
M-3 5/	31	199	89.9	0	0.5	0	0	0	0	0	91.0	0	3.0	1.0	1.0	0	0	0	63.8	0	3.0	0.5	0	0	18.6	18.6
M-1 3/	52	199	0	3.0	22.0	5.0	1.0	1.0	0.5	1.5	0	3.0	22.0	5.0	1.0	1.0	0.5	1.5	0	3.0	23.0	5.0	2.0	1.0	0.5	2.5
M-2 4/	52	200	0	1.0	11.0	0	0	4.0	2.0	6.0	0	0.5	12.0	0	0	4.5	2.0	6.5	0	0.5	12.0	0	0	5.0	20	7.0
M-3 5/	52	199	0	0	11.0	2.0	0.5	0	0.5	1.0	0	0	11.0	2.0	0.5	0	0.5	1.0	0	0	11.0	2.0	0.5	0	0.5	1.0

1/ Fruit sized in orchard (80's and 96's) and placed in storage March 23, 1950 with no treatment other than plain wraps.

2/ Decay data, 2nd and 3rd inspections, cumulative. Surface browning, pitting and aging data not cumulative.

3/ M-1 plot sprayed Oct. 6, and Dec. 21, 1949. (8 p.p.m. 2,4-D acid equivalent).

4/ M-2 plot sprayed Dec. 21, 1949. (16 p.p.m. 2,4-D acid equivalent).

5/ M-3 plot - check - no spray.